
D1001619-v1 (ilspmc_fieldbox4)

aLIGO PSL Circuit Board Documentation

Patrick Kwee, 23 Jun 2010

Abstract

Fieldbox for injection locking the high power oscillator to the frontend and for locking the PMC. More information is available in LIGO-T0900577.

Testplan Template: T1000343-v1

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Safety Instructions

In order to operate the circuit properly and safely, review the following guidelines before installing and using the unit. Failure to do so may result in equipment damage or bodily injury:



This circuit was designed as a laboratory equipment to be operated only by trained and qualified technicians in research institutes or development departments. For safety reasons, usage by other persons or in other environments is *not* recommended.



- This circuit uses extra-low voltage ($< 50 V_{AC}$ and $< 75 V_{DC}$) and is therefore exempt from the regulations of the *Low Voltage Directive* (2006/95/EC).
 - The unit does not contain any mechanical drive system. Therefore, the regulations of the *Machinery Directive* (2006/42/EC) do not apply.
-

Sicherheitshinweise

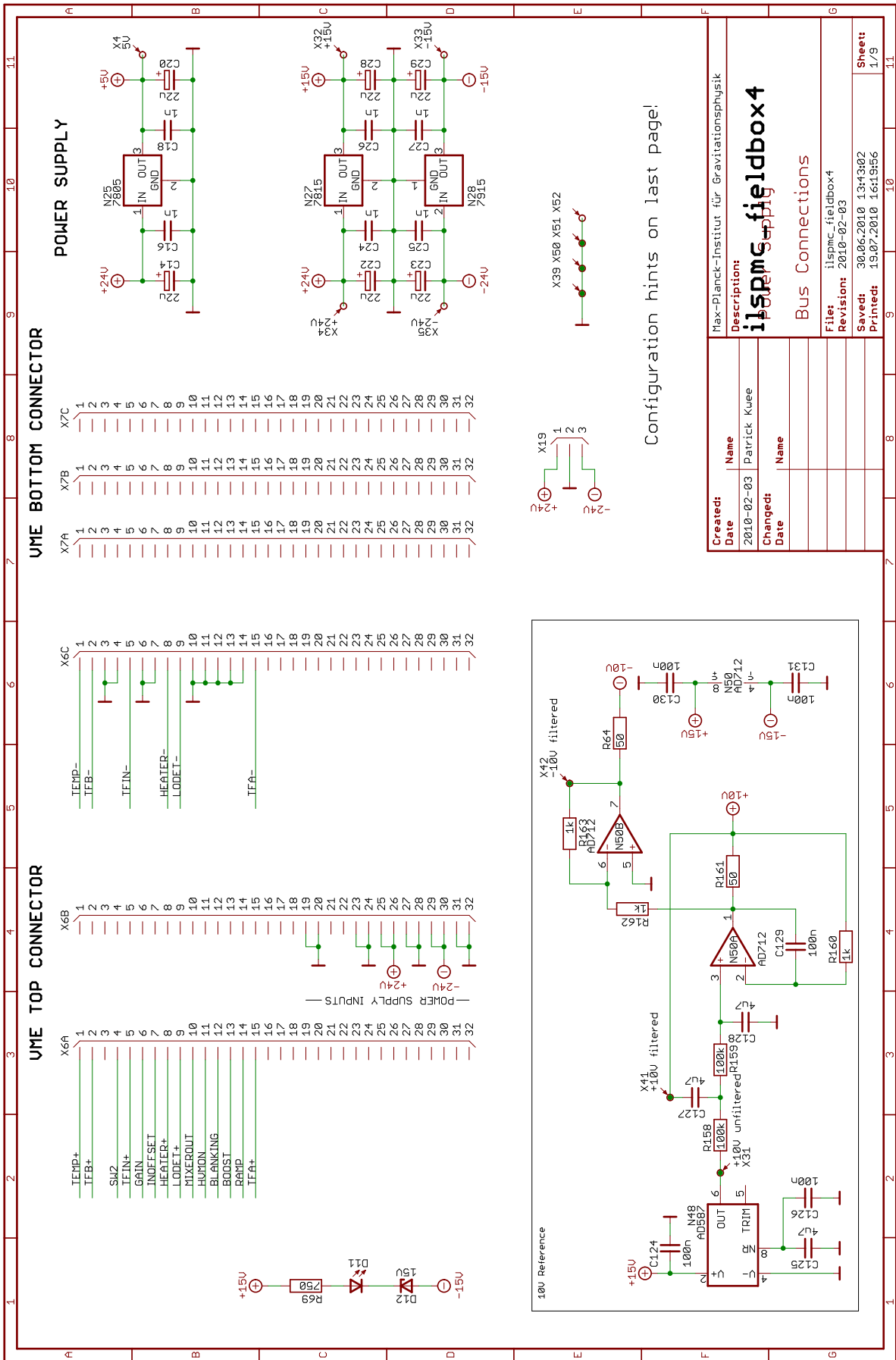
Nehmen Sie vor Aufbau und Inbetriebnahme des Geräts folgende Empfehlungen zur Kenntnis, um die Schaltung korrekt und sicher zu betreiben sowie Schäden und Verletzungen zu vermeiden:



Diese Schaltung wurde als Laborausstattung entworfen, die nur von qualifizierten und eingewiesenen Technikern in Forschungsinstituten oder Entwicklungsabteilungen benutzt wird. Aus Sicherheitsgründen wird die Verwendung durch andere Personen oder in anderer Umgebung *nicht* empfohlen.



- Diese Schaltung verwendet Kleinspannung ($< 50 V_{AC}$ und $< 75 V_{DC}$) und unterliegt daher nicht den Bestimmungen der *Niederspannungsrichtlinie* (2006/95/EC).
 - Das Gerät enthält kein mechanisches Antriebssystem – die Bestimmungen der *Maschinenrichtlinie* (2006/42/EC) sind daher nicht anwendbar.
-

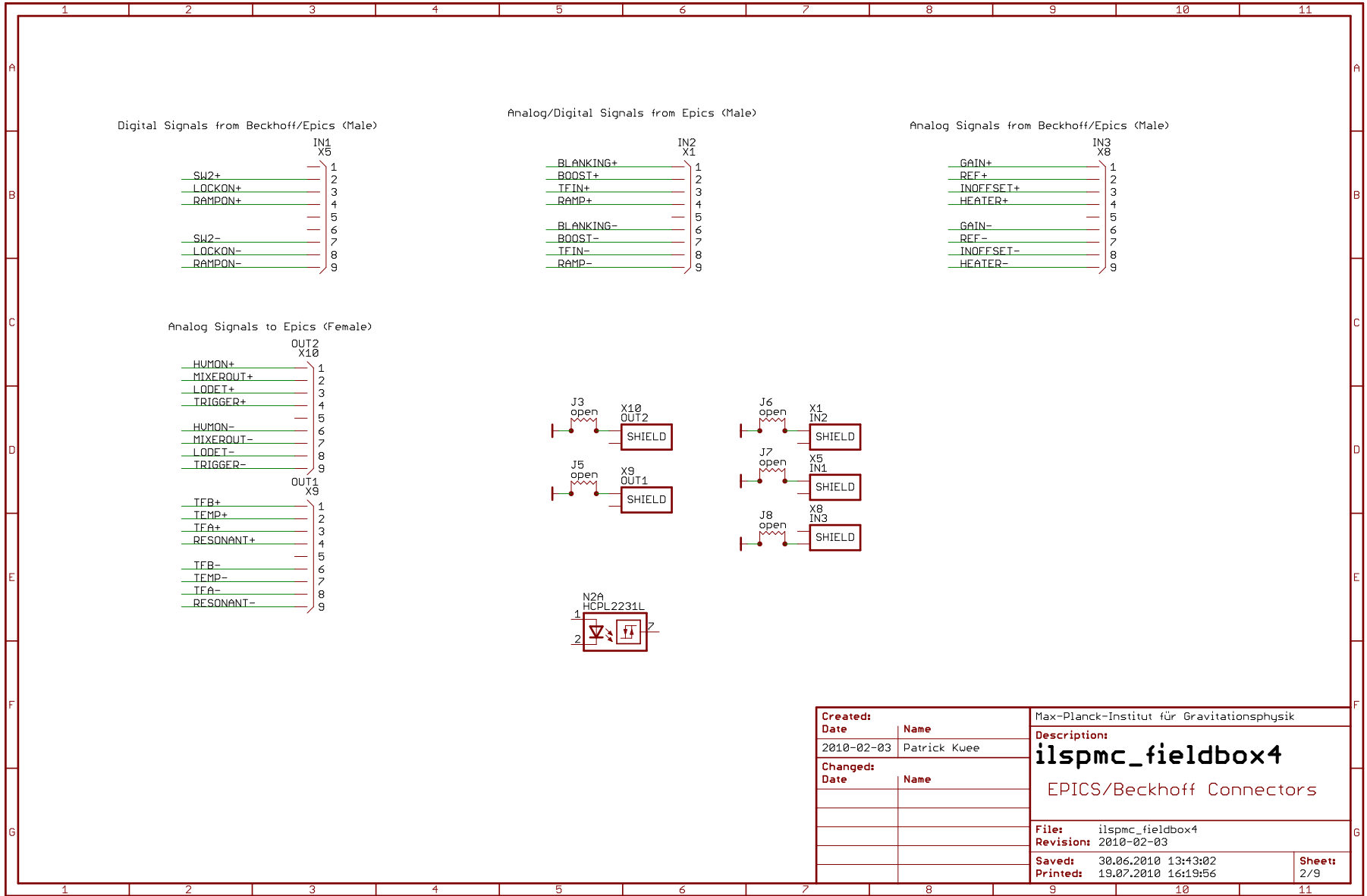


Configuration hints on last page!

Created:	Name
Date	Patrick Kuee
Changed:	
Date	
Bus Connections	
File:	ilspmc_fieldbox4
Revision:	2010-02-03
Saved:	30.06.2010 13:43:02
Printed:	19.07.2010 16:19:56
Sheet:	1/9

Figure 1: Project schematics (sheet 1)

Figure 2: Project schematics (sheet 2)



Created:		Max-Planck-Institut für Gravitationsphysik
Date:	Name:	Description:
2010-02-03	Patrick Kuee	ilspmc_fieldbox4
Changed:		EPICS/Beckhoff Connectors
Date:	Name:	
		File: ilspmc_fieldbox4
		Revision: 2010-02-03
		Saved: 30.06.2010 13:43:02
		Printed: 19.07.2010 16:19:56
		Sheet: 2/9

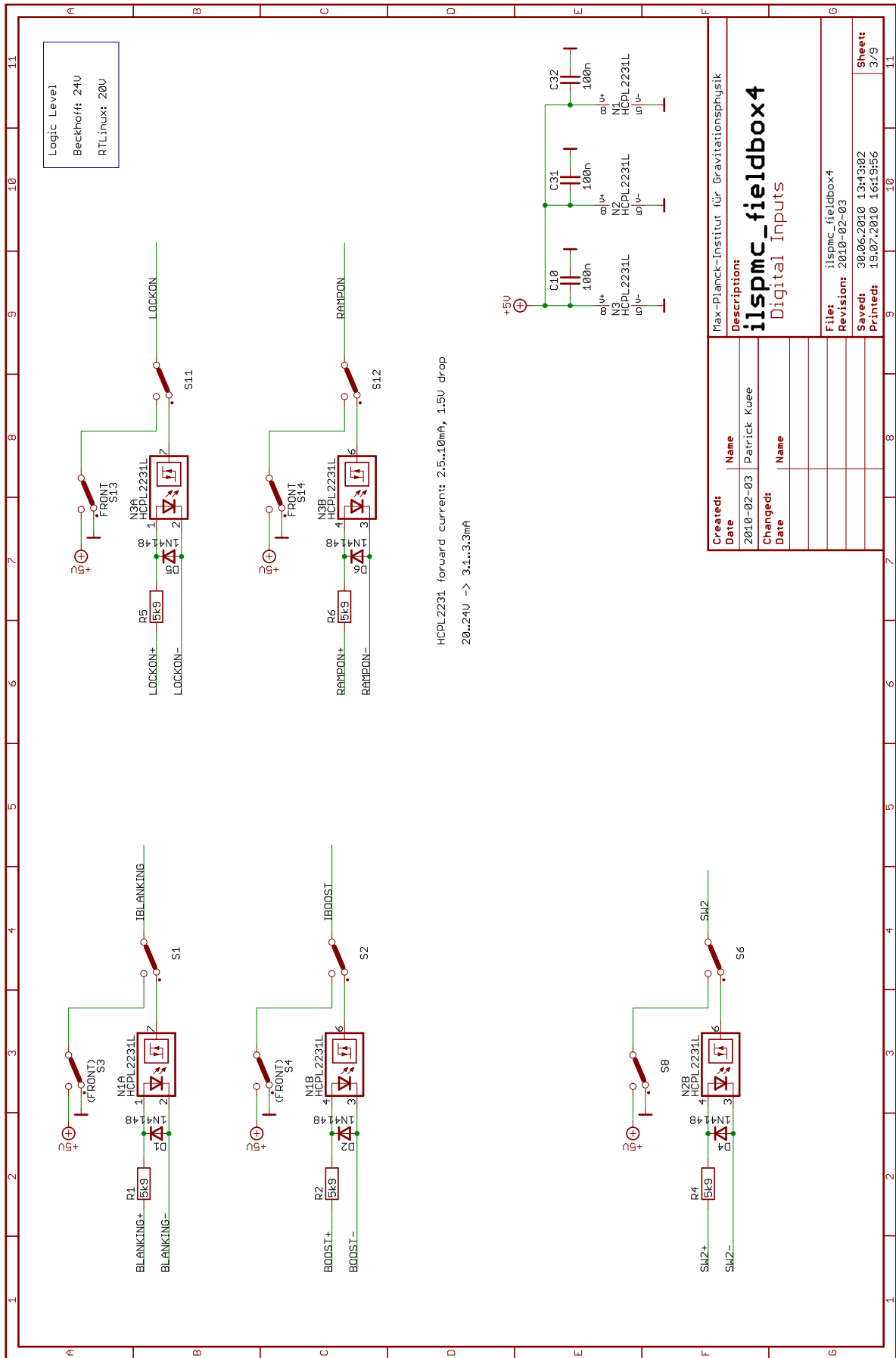


Figure 3: Project schematics (sheet 3)

Figure 4: Project schematics (sheet 4)

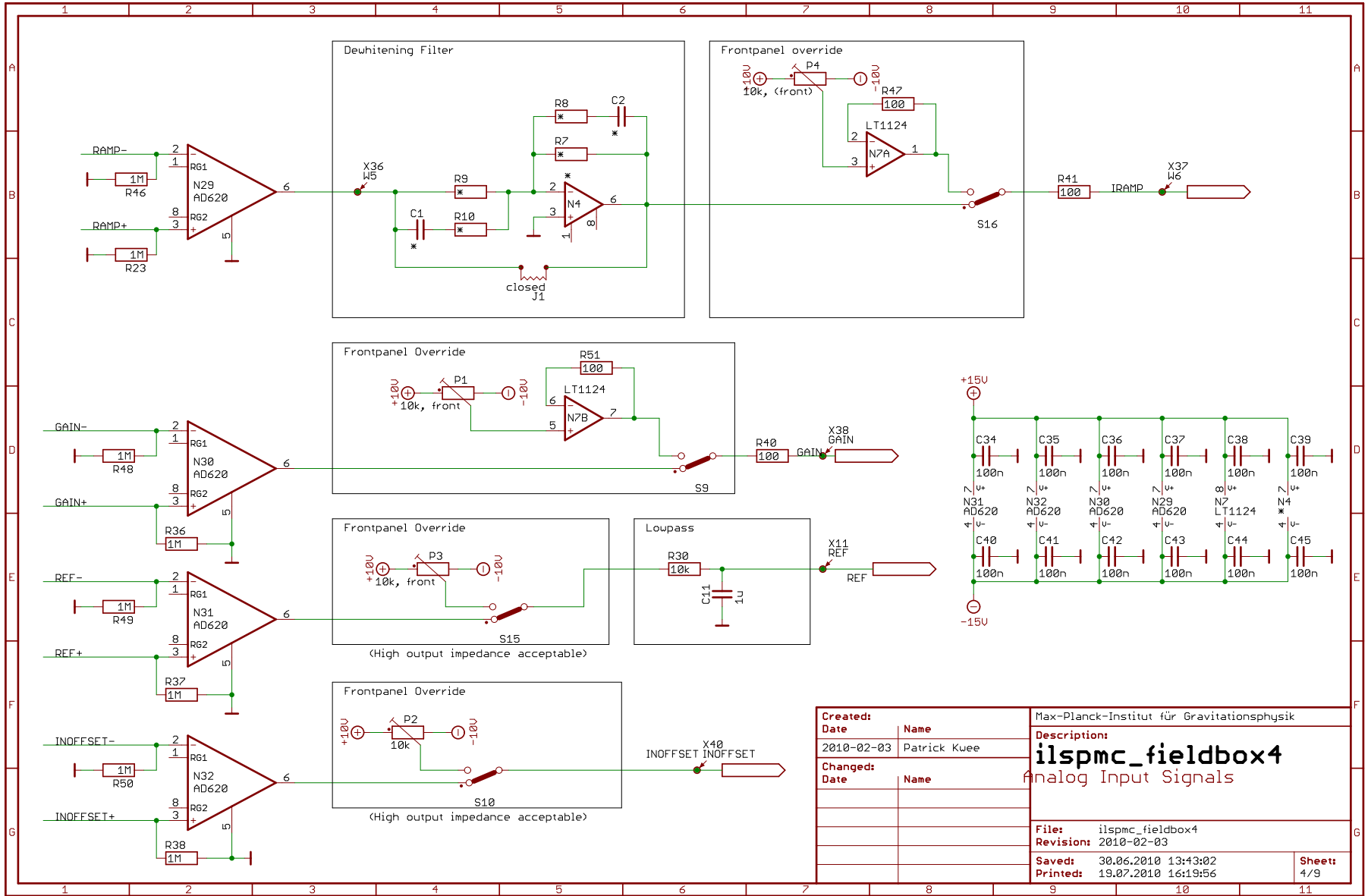
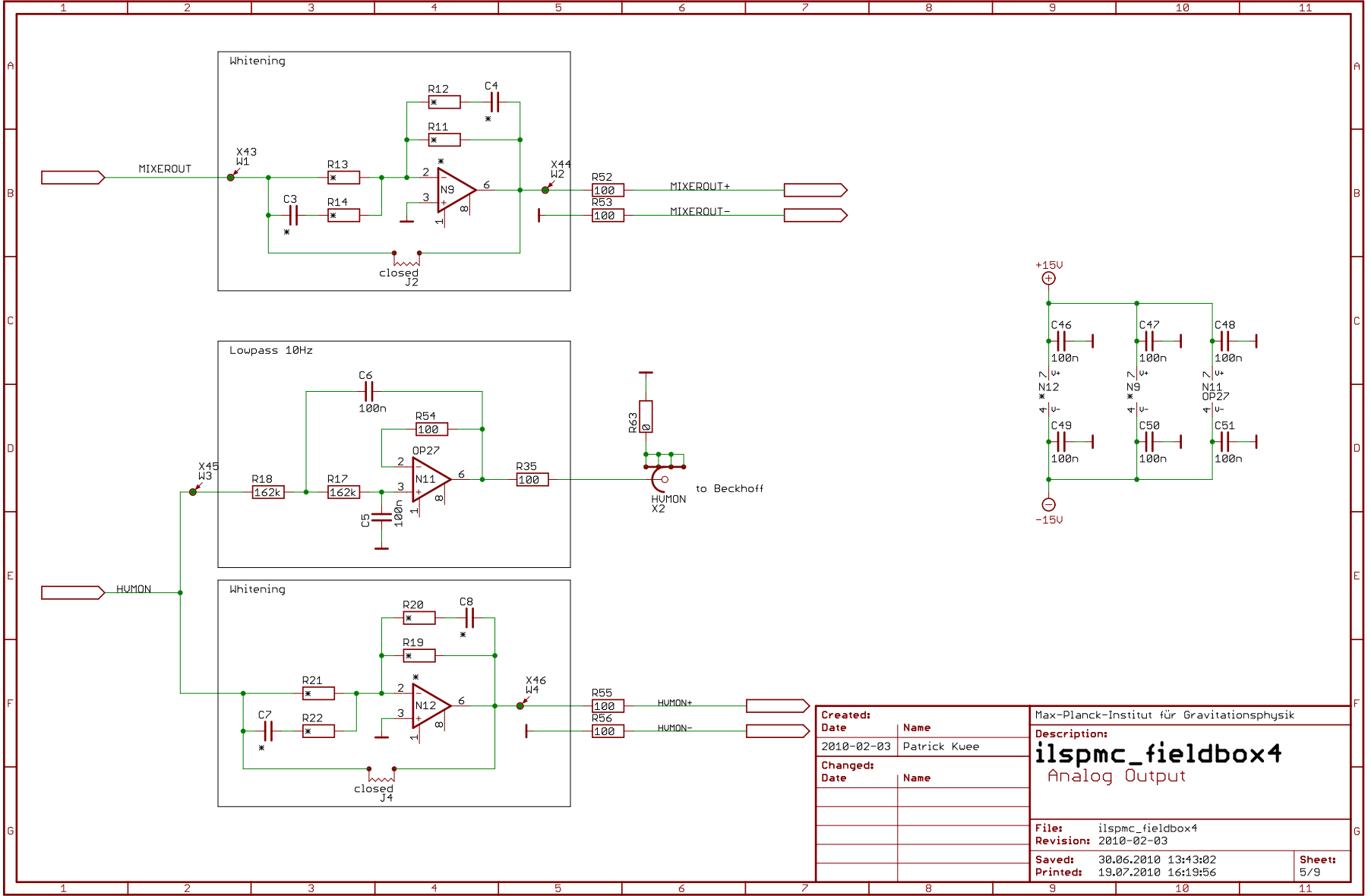
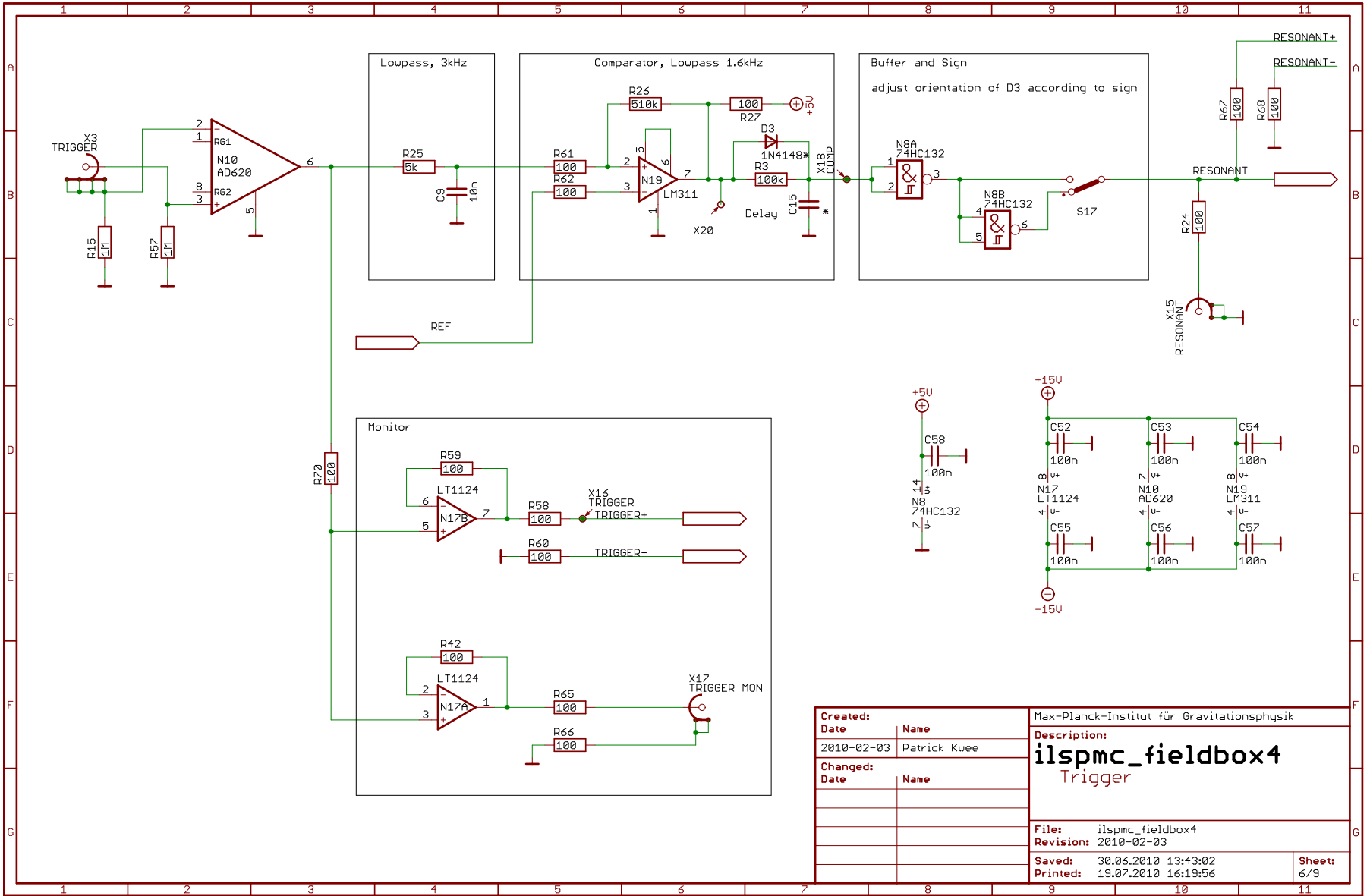


Figure 5: Project schematics (sheet 5)

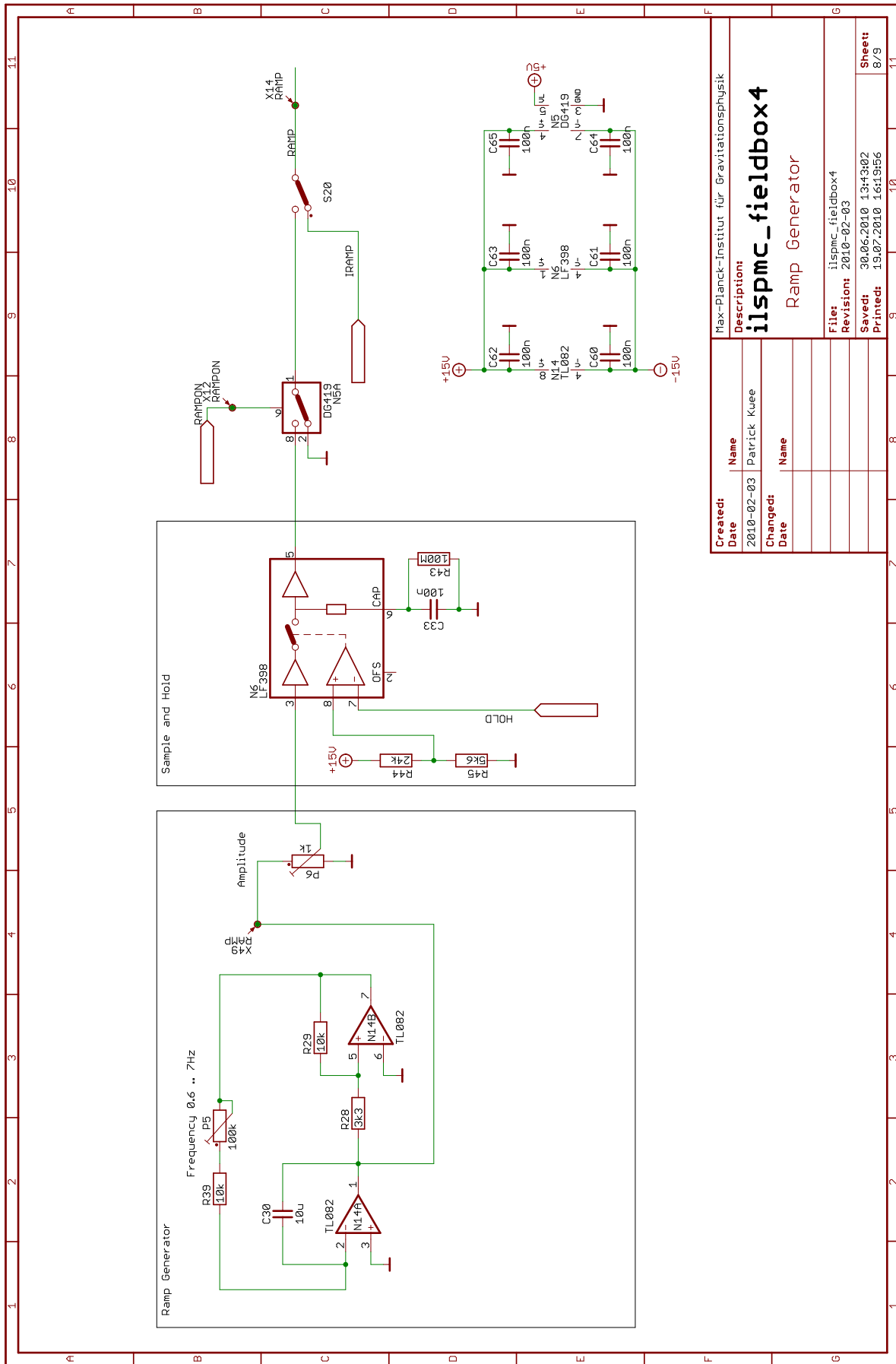


Created:		Max-Planck-Institut für Gravitationsphysik	
Date	Name	Description:	
2010-02-03	Patrick Kuee	ilspmc_fieldbox4	
Changed:		Analog Output	
Date	Name	File: ilspmc_fieldbox4	
		Revision: 2010-02-03	
		Saved: 30.06.2010 13:43:02	
		Printed: 19.07.2010 16:19:56	
		Sheet:	5/9

Figure 6: Project schematics (sheet 6)



Created:		Max-Planck-Institut für Gravitationsphysik	
Date	Name	Description:	
2010-02-03	Patrick Kuee	ilspmc_fieldbox4	
Changed:		Trigger	
Date	Name	File: ilspmc_fieldbox4	
		Revision: 2010-02-03	
		Saved: 30.06.2010 13:43:02	Sheet: 6/9
		Printed: 19.07.2010 16:19:56	



Created:		Description:	
Date	Name	Max-Planck-Institut für Gravitationsphysik	
2010-02-03	Patrick Kuee	ilspmc_fieldbox4	
Changed:		Ramp Generator	
Date	Name	File:	ilspmc_fieldbox4
		Revision:	2010-02-03
		Saved:	30.06.2010 13:43:02
		Printed:	19.07.2010 16:19:56
		Sheet:	8/9

Figure 8: Project schematics (sheet 8)

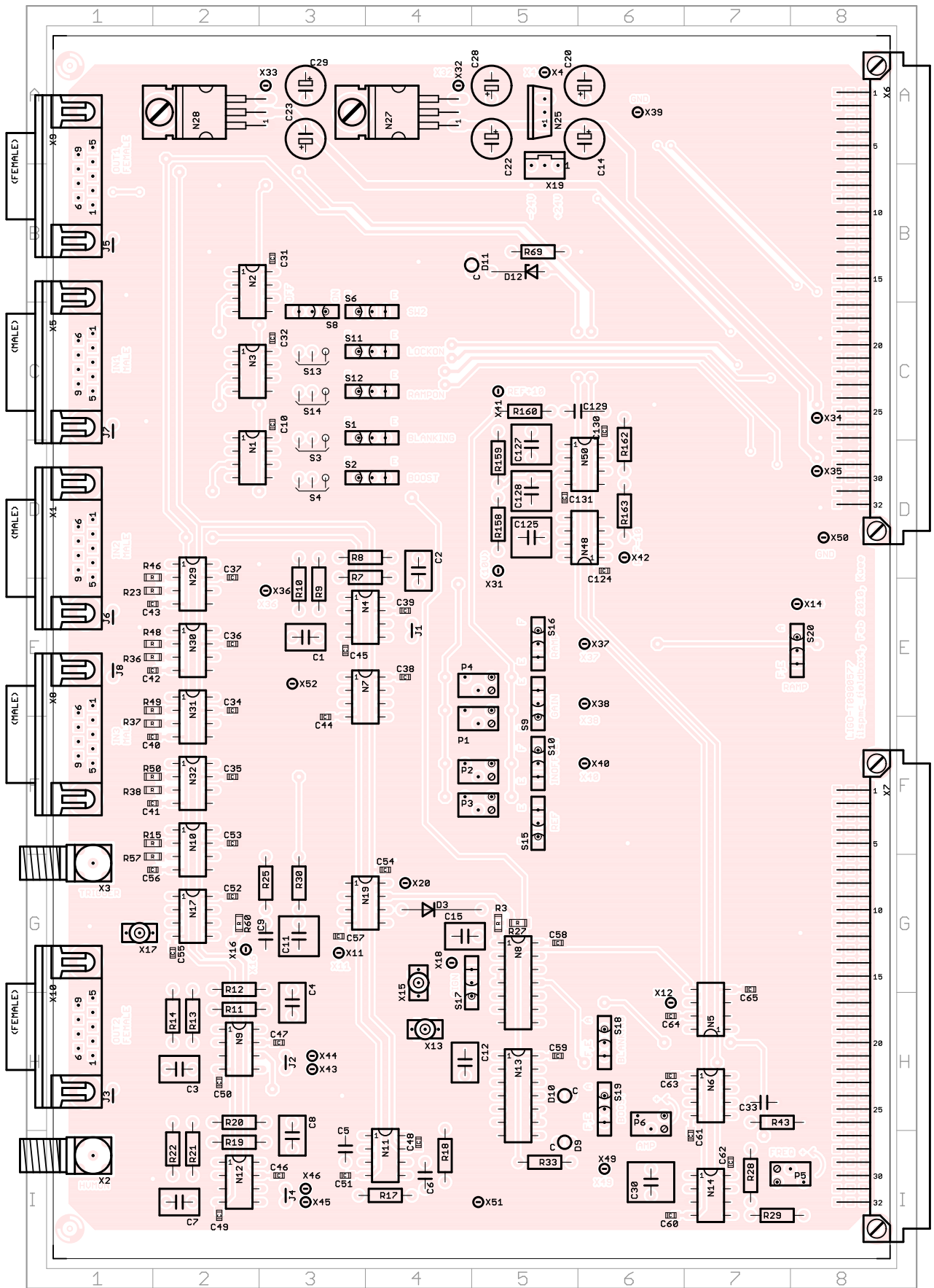


Figure 10: Board top view showing placeplan with component names

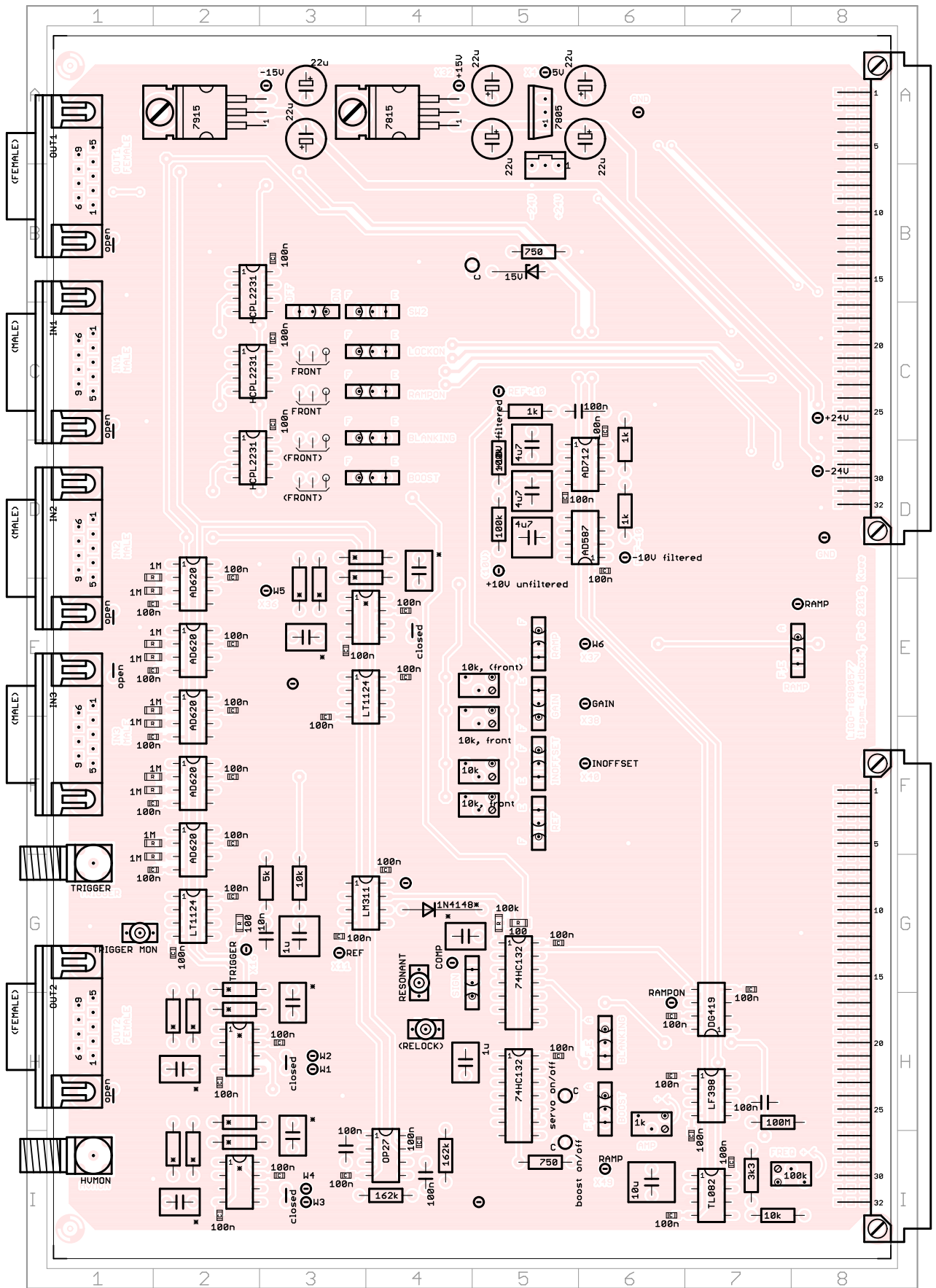


Figure 11: Board top view showing placeplan with component values

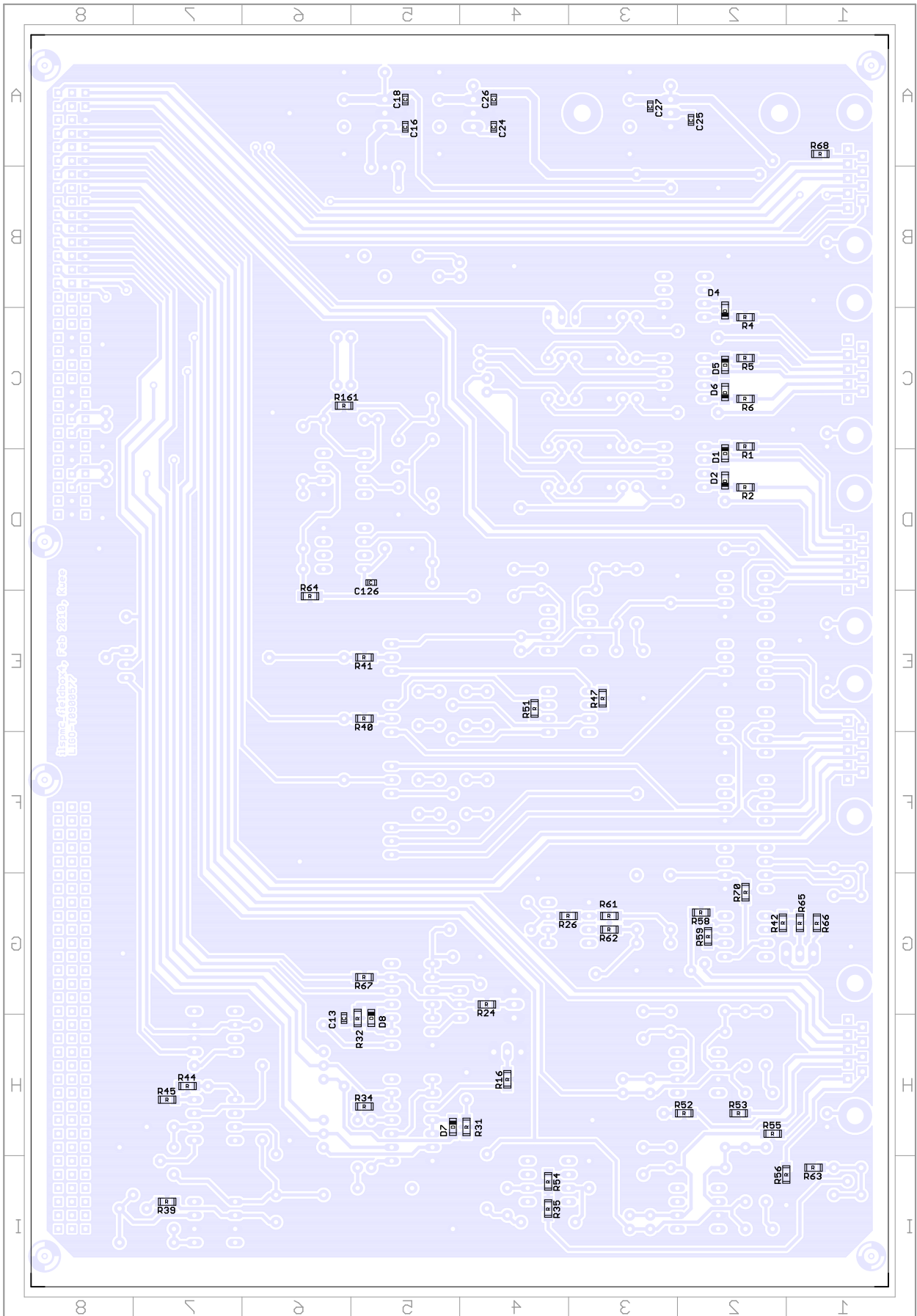


Figure 12: Board bottom view showing placeplan with component names

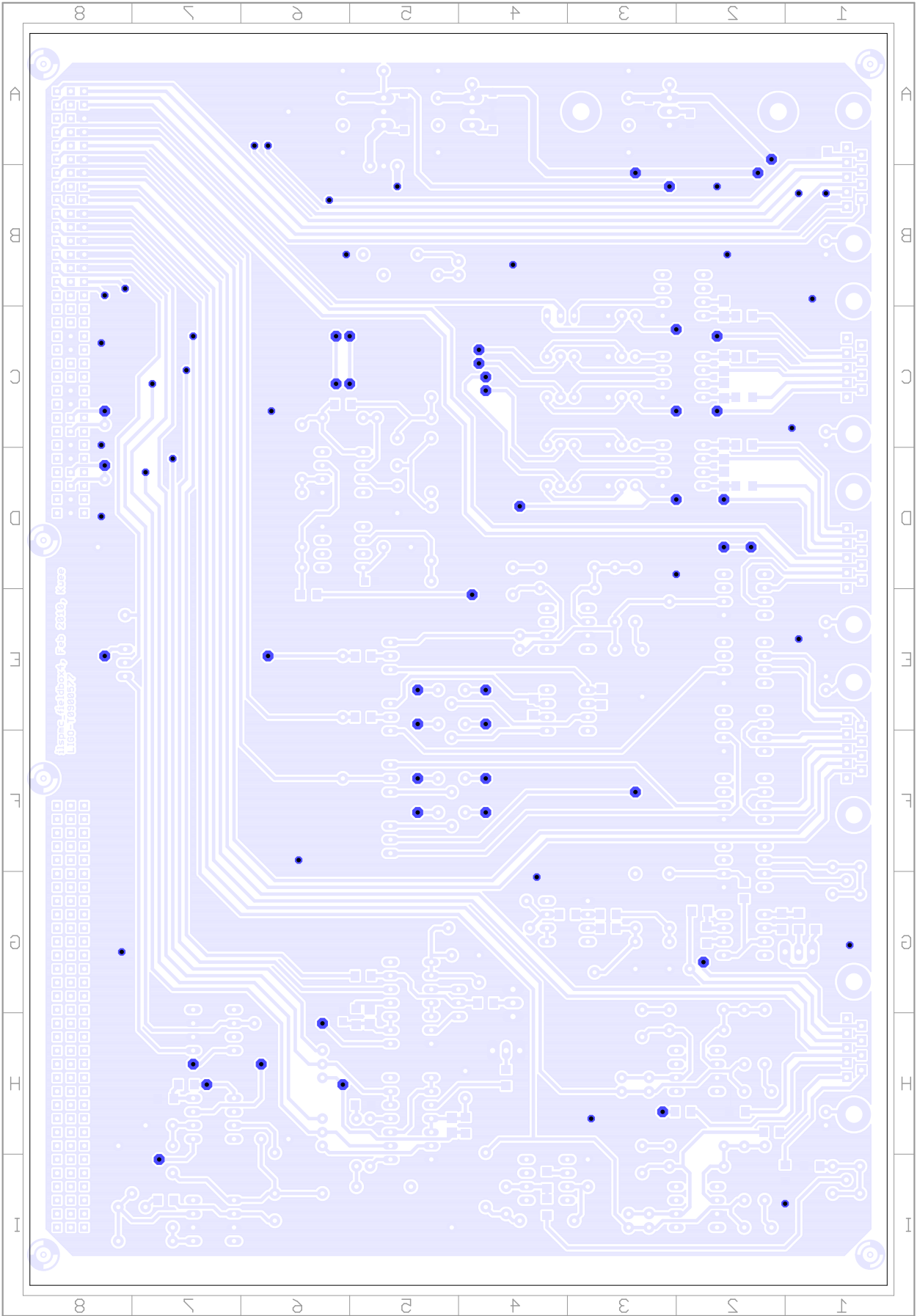


Figure 15: Board bottom view showing connectors, test points, vias and wired components

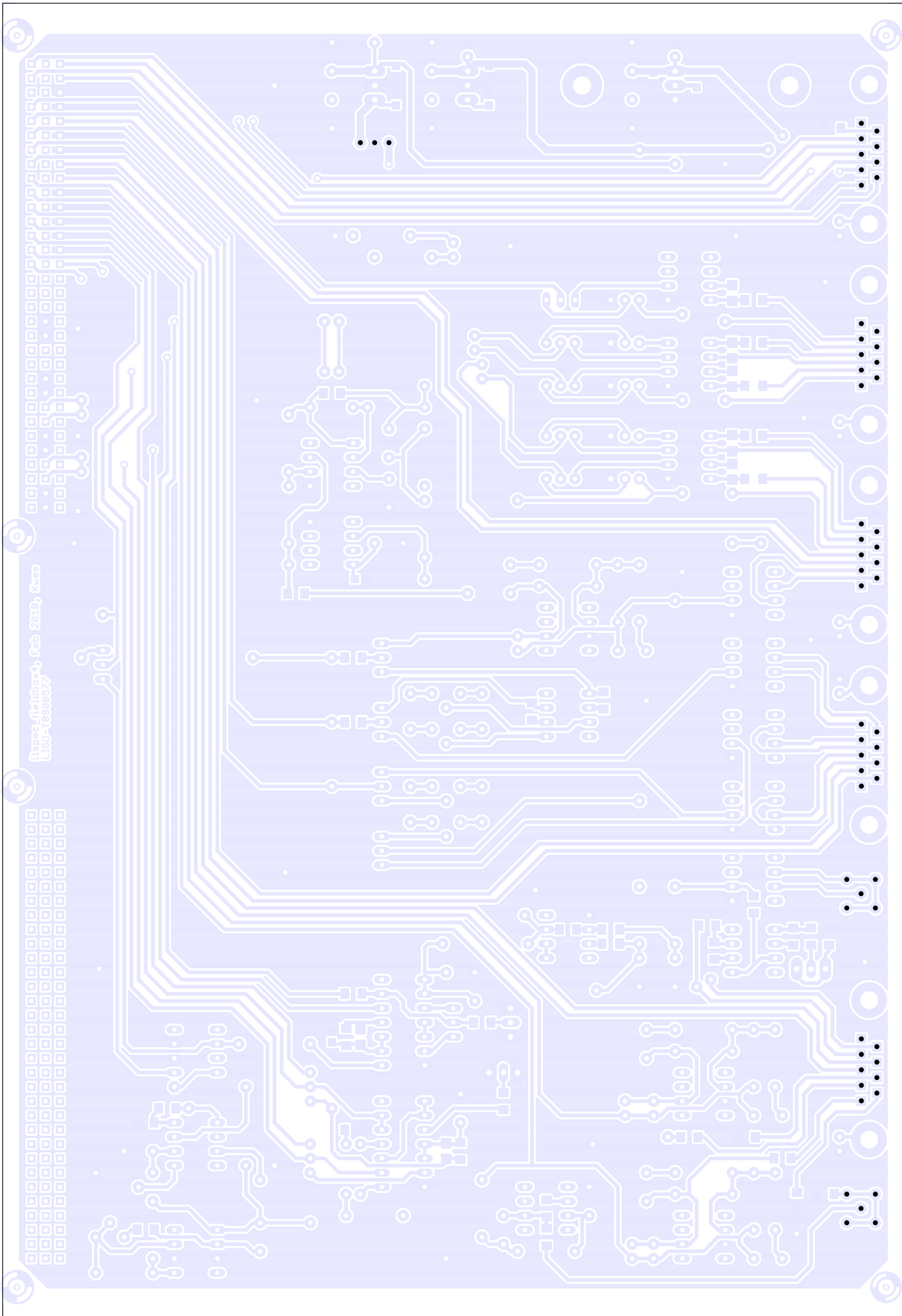


Figure 16: Board bottom view showing drills with 0.9 mm (0.035 in) diameter

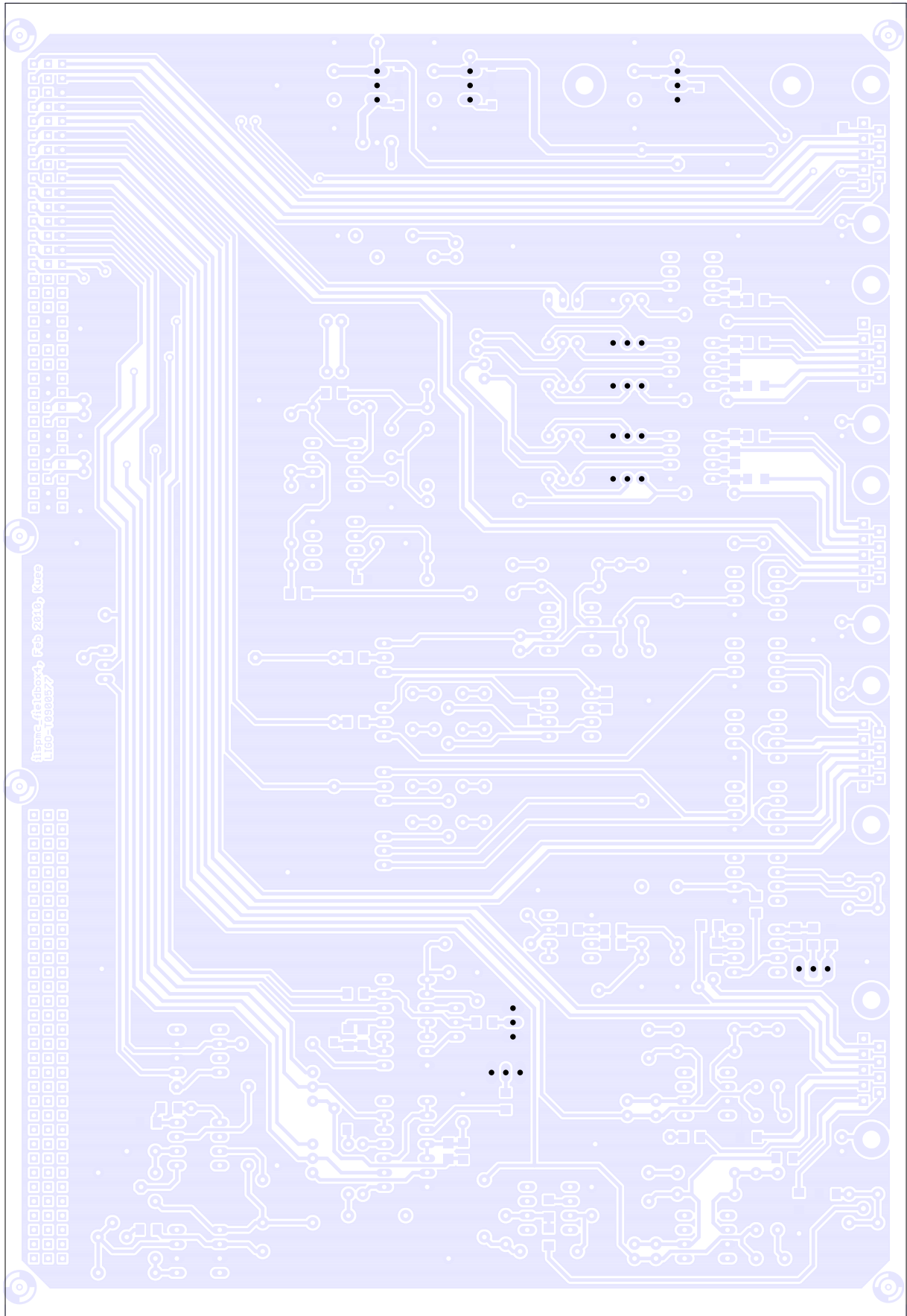


Figure 17: Board bottom view showing drills with 1.0 mm (0.039 in) diameter

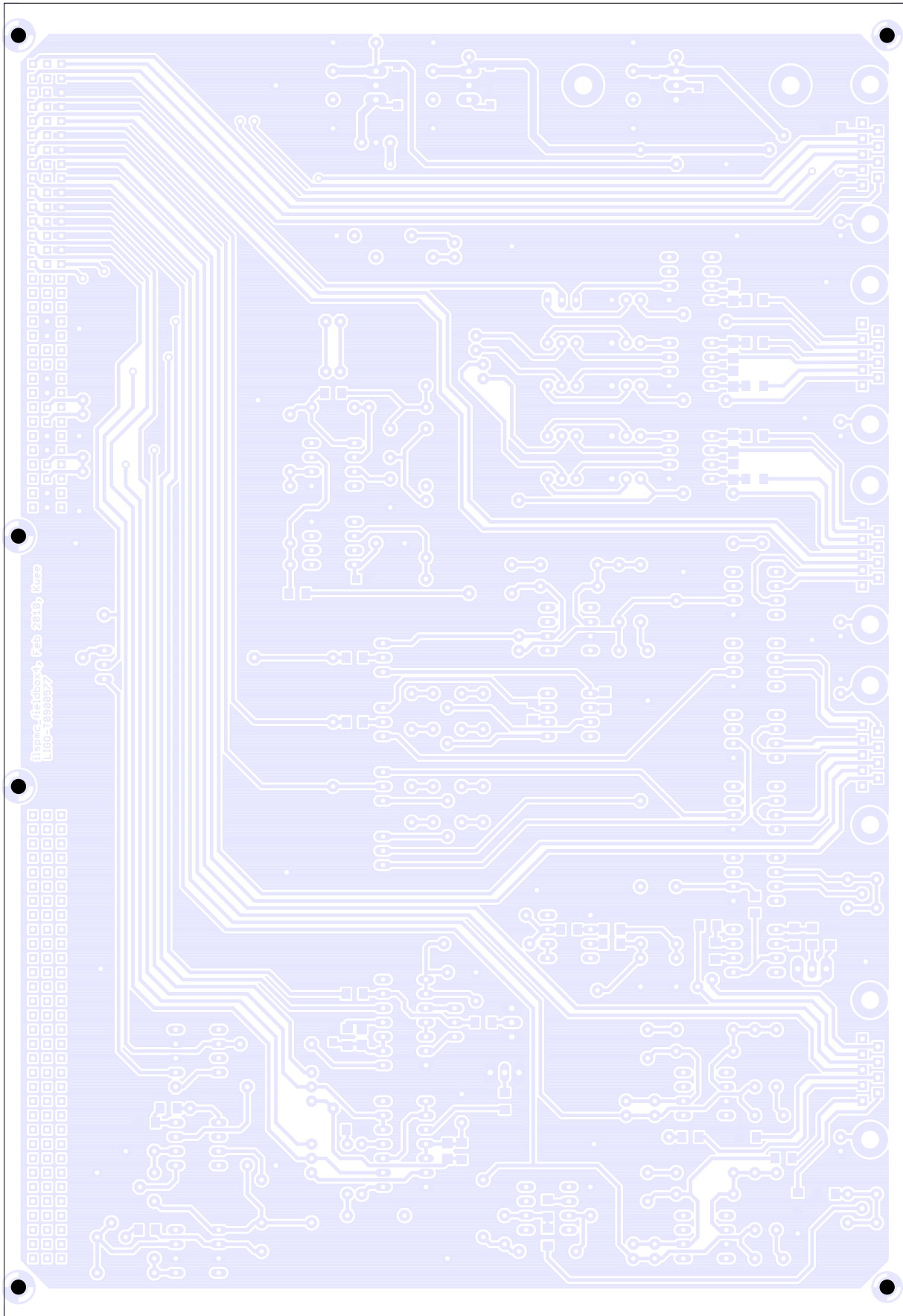


Figure 18: Board bottom view showing drills with 2.7 mm (0.106 in) diameter

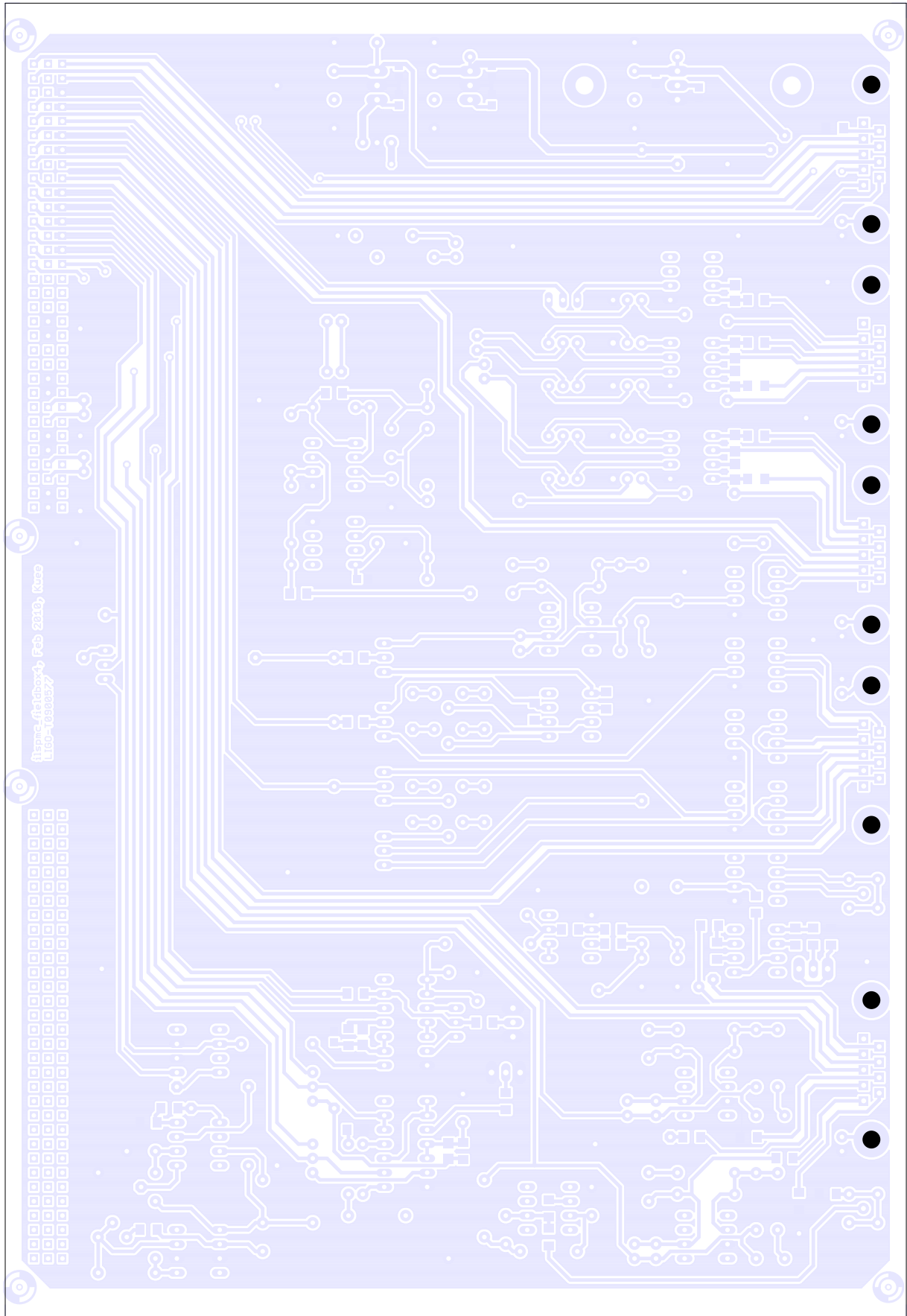


Figure 19: Board bottom view showing drills with 3.2 mm (0.125 in) diameter

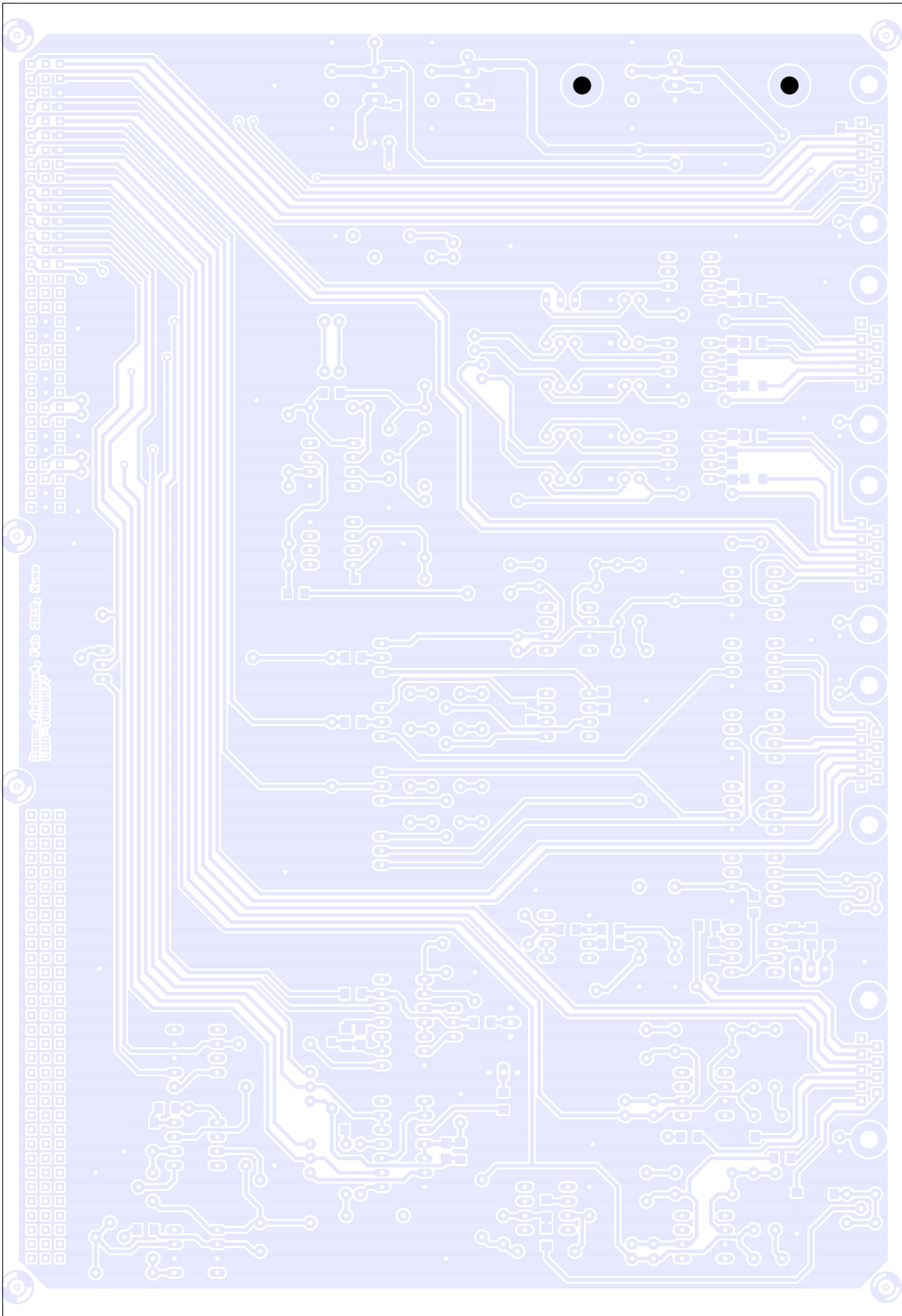


Figure 20: Board bottom view showing drills with 3.2 mm (0.126 in) diameter

Circuit Lists

Drill list: The following table shows all *final* drill diameters used in the board. When manually drilling the clearance holes, round up to the nearest available drill bit diameter, ensuring that all components fit well. When manufacturing *through-plated* boards, adjust for the additional copper coating by increasing the diameter accordingly.

\varnothing [μm]	\varnothing [mm]	\varnothing [in]	Count
812	0.8	0.032	667
889	0.9	0.035	58
990	1.0	0.039	30
2692	2.7	0.106	6
3175	3.2	0.125	10
3200	3.2	0.126	2
Total			773

Table 1: Drill diameters used in the board

Standard properties: If not explicitly stated otherwise in the schematics or value and part lists, the circuit components have the following standard properties. Parts with ‘better’ properties can be easily substituted, but care should be taken if the specifications are *not* met.

- Wired resistors: Metal film 0.6 W, 1%, 200 V, TK 100
- SMD resistors: 1%, 150 V, TK 50, MiniMELF in thin film, other packages in thick film technology

Value list: The following list shows all components available on the board (sorted by part *values*) and can be used to quickly gather components. Additional information can possibly be found directly on the board (or in the schematics).

```

1 EAGLE Version 5.10.0 Copyright (c) 1988-2010 CadSoft
2 Board value list of 'ilspmc_fieldbox4.brd'
3 Exported at 2010-07-19 16:20
4 Created with macro 'plot.ulp' (c) Andreas Weidner
5 Shown are: Value/Type,Package,Number,Names (Library)
6
7 ---C---
8 1n          C-SMD:0805          (6*)   C16,C18,C24,C25,C26,C27 (miscs)
9 1n5         C-SMD:0805          (1*)   C13 (miscs)
10 10n         C-0.2"                (1*)   C9 (miscs)
11 100n        C-0.2"                (3*)   C5,C6,C33 (miscs)
12            C-0.3"                (1*)   C129 (miscs)
13            C-SMD:0805          (39*)  C10,C31,C32,C34,C35,C36,C37,C38,C39,
14            C40,C41,C42,C43,C44,C45,C46,C47,C48,
15            C49,C50,C51,C52,C53,C54,C55,C56,C57,
16            C58,C59,C60,C61,C62,C63,C64,C65,C124,
17            C126,C130,C131 (miscs)
18 1u          C02A                (1*)   C11 (miscs)
19            C02B                (1*)   C12 (miscs)
20 4u7         C02A                (3*)   C125,C127,C128 (miscs)
21 10u         C02C                (1*)   C30 (miscs)
22 22u         CE02D           (6*)   C14,C20,C22,C23,C28,C29 (miscs)
23 *          C02B                (7*)   C1,C2,C3,C4,C7,C8,C15 (miscs)
24
25 ---D---
26 1N4148      D-SMD:MiniMELF         (7*)   D1,D2,D4,D5,D6,D7,D8 (diodes)
27 1N4148*     D-0.6"                (1*)   D3 (diodes)
28 15V         DZ-0.4"                (1*)   D12 (diodes)
29 [undefined] LED-3mm          (1*)   D11 (optos)

```

30	boost on/off	LED-3mm	(1*)	D9 (optos)
31	servo on/off	LED-3mm	(1*)	D10 (optos)
32				
33	---J---			
34	closed	JMP:Wire-0.1"	(3*)	J1,J2,J4 (connectors)
35	open	JMP:Wire-0.1"	(5*)	J3,J5,J6,J7,J8 (connectors)
36				
37	---N---			
38	7815	TO220L	(1*)	N27 (ics)
39	7915	TO220L	(1*)	N28 (ics)
40	74HC132	DIP-14	(2*)	N8,N13 (digitals)
41	7805	TO-220	(1*)	N25 (ics)
42	AD587	DIP-8	(1*)	N48 (ics)
43	AD620	DIP-8	(5*)	N10,N29,N30,N31,N32 (opamps)
44	AD712	DIP-8	(1*)	N50 (opamps)
45	DG419	DIP-8	(1*)	N5 (ics)
46	HCPL2231	DIP-8	(3*)	N1,N2,N3 (optos)
47	LF398	DIP-8	(1*)	N6 (ics)
48	LM311	DIP-8	(1*)	N19 (opamps)
49	LT1124	DIP-8	(2*)	N7,N17 (opamps)
50	OP27	DIP-8	(1*)	N11 (opamps)
51	OP27*	DIP-8	(3*)	N4,N9,N12 (opamps)
52	TL082	DIP-8	(1*)	N14 (opamps)
53				
54	---P---			
55	1k	PT01N	(1*)	P6 (miscs)
56	10k	PT01N	(1*)	P2 (miscs)
57	10k, (front)	PT01N	(1*)	P4 (miscs)
58	10k, front	PT01N	(2*)	P1,P3 (miscs)
59	100k	PT01N	(1*)	P5 (miscs)
60				
61	---R---			
62	0	R-SMD:1206	(1*)	R63 (miscs)
63	50	R-SMD:1206	(2*)	R64,R161 (miscs)
64	100	R-SMD:1206	(24*)	R16,R24,R27,R35,R40,R41,R42,R47,R51, R52,R53,R54,R55,R56,R58,R59,R60,R61, R62,R65,R66,R67,R68,R70 (miscs)
65				
66				
67	750	R-0.4"	(2*)	R33,R69 (miscs)
68		R-SMD:1206	(1*)	R34 (miscs)
69	1k	R-0.4"	(3*)	R160,R162,R163 (miscs)
70	3k3	R-0.4"	(1*)	R28 (miscs)
71	5k	R-0.4"	(1*)	R25 (miscs)
72	5k6	R-SMD:1206	(1*)	R45 (miscs)
73	5k9	R-SMD:1206	(5*)	R1,R2,R4,R5,R6 (miscs)
74	10k	R-0.4"	(2*)	R29,R30 (miscs)
75		R-SMD:1206	(1*)	R39 (miscs)
76	24k	R-SMD:1206	(1*)	R44 (miscs)
77	56k	R-SMD:1206	(1*)	R32 (miscs)
78	100k	R-0.4"	(2*)	R158,R159 (miscs)
79		R-SMD:1206	(2*)	R3,R31 (miscs)
80	162k	R-0.4"	(2*)	R17,R18 (miscs)
81	510k	R-SMD:1206	(1*)	R26 (miscs)
82	1M	R-SMD:1206	(10*)	R15,R23,R36,R37,R38,R46,R48,R49,R50,R57 (miscs)
83				
84	100M	R-0.4"	(1*)	R43 (miscs)
85	*	R-0.4"	(12*)	R7,R8,R9,R10,R11,R12,R13,R14,R19,R20, R21,R22 (miscs)
86				
87				
88	---S---			

89	(FRONT)	S1X2W01N	(2*)	S3,S4 (miscs)
90	FRONT	S1X2W01N	(2*)	S13,S14 (miscs)
91	[undefined]	S1X2S01L	(7*)	S6,S9,S10,S15,S16,S17,S20 (miscs)
92		S1X2S01N	(7*)	S1,S2,S8,S11,S12,S18,S19 (miscs)
93				
94	---X---			
95	-24V	Testpin:0.8mm/ceramic	(1*)	X35 (connectors)
96	-15V	Testpin:0.8mm/ceramic	(1*)	X33 (connectors)
97	-10V filtered	Testpin:0.8mm/ceramic	(1*)	X42 (connectors)
98	5V	Testpin:0.8mm/ceramic	(1*)	X4 (connectors)
99	+10V filtered	Testpin:0.8mm/ceramic	(1*)	X41 (connectors)
100	+10V unfiltered	Testpin:0.8mm/ceramic	(1*)	X31 (connectors)
101	+15V	Testpin:0.8mm/ceramic	(1*)	X32 (connectors)
102	+24V	Testpin:0.8mm/ceramic	(1*)	X34 (connectors)
103	(RELOCK)	Crimp:RG174/vert.	(1*)	X13 (connectors)
104	COMP	Testpin:0.8mm/ceramic	(1*)	X18 (connectors)
105	GAIN	Testpin:0.8mm/ceramic	(1*)	X38 (connectors)
106	HVMON	LEMO:1-pin/horz.	(1*)	X2 (connectors)
107	IN1	X09-DSUBMALE1	(1*)	X5 (connectors)
108	IN2	X09-DSUBMALE1	(1*)	X1 (connectors)
109	IN3	X09-DSUBMALE1	(1*)	X8 (connectors)
110	INOFFSET	Testpin:0.8mm/ceramic	(1*)	X40 (connectors)
111	OUT1	X09-DSUBFEMALE1	(1*)	X9 (connectors)
112	OUT2	X09-DSUBFEMALE1	(1*)	X10 (connectors)
113	RAMP	Testpin:0.8mm/ceramic	(2*)	X14,X49 (connectors)
114	RAMPON	Testpin:0.8mm/ceramic	(1*)	X12 (connectors)
115	REF	Testpin:0.8mm/ceramic	(1*)	X11 (connectors)
116	RESONANT	Crimp:RG174/vert.	(1*)	X15 (connectors)
117	TRIGGER	LEMO:1-pin/horz.	(1*)	X3 (connectors)
118		Testpin:0.8mm/ceramic	(1*)	X16 (connectors)
119	TRIGGER MON	Crimp:RG174/vert.	(1*)	X17 (connectors)
120	W1	Testpin:0.8mm/ceramic	(1*)	X43 (connectors)
121	W2	Testpin:0.8mm/ceramic	(1*)	X44 (connectors)
122	W3	Testpin:0.8mm/ceramic	(1*)	X45 (connectors)
123	W4	Testpin:0.8mm/ceramic	(1*)	X46 (connectors)
124	W5	Testpin:0.8mm/ceramic	(1*)	X36 (connectors)
125	W6	Testpin:0.8mm/ceramic	(1*)	X37 (connectors)
126	[undefined]	Backplane:96-pin/ABC	(2*)	X6,X7 (connectors)
127		Testpin:0.8mm/ceramic	(5*)	X20,X39,X50,X51,X52 (connectors)
128		X03AN	(1*)	X19 (connectors)

Part list: The following list shows all components available in the schematics (sorted by part *names*) and can be used to quickly locate components. The column *Layer/Cell* shows the position of the part on the board: *T* for top side and *B* for bottom side, followed by the cell of the surrounding frame (if available). The column *Sheets/Cells* shows the position of *all* the part's gates in the schematics: Sheet number followed by the cell of the surrounding frame (if available). Additional information can possibly be found directly in the schematics.

```

1 EAGLE Version 5.10.0 Copyright (c) 1988-2010 CadSoft
2 Schematics part list of 'ilspmc_fieldbox4.sch'
3 Exported at 2010-07-19 16:20
4 Created with macro 'plot.ulp' (c) Andreas Weidner
5 Shown are: Name,Value/Type,Package,Device,Layer/Cell,Sheets/Cells

```

7	---C---				
8	C1	*	C02B	C02B	T-E3 4-B4
9	C2	*	C02B	C02B	T-D4 4-A5
10	C3	*	C02B	C02B	T-H2 5-B3
11	C4	*	C02B	C02B	T-H3 5-A4

12	C5	100n	C-0.2"	C	T-I3	5-E4
13	C6	100n	C-0.2"	C02	T-I4	5-D3
14	C7	*	C02B	C02B	T-I2	5-F3
15	C8	*	C02B	C02B	T-I3	5-E4
16	C9	10n	C-0.2"	C	T-G3	6-B4
17	C10	100n	C-SMD:0805	CS	T-C3	3-E9
18	C11	1u	C02A	C02A	T-G3	4-E6
19	C12	1u	C02B	C02B	T-H4	7-C4
20	C13	1n5	C-SMD:0805	CS	B-H6	7-E4
21	C14	22u	CE02D	CE02D	T-A6	1-B9
22	C15	*	C02B	C02B	T-G4	6-B7
23	C16	1n	C-SMD:0805	CS	B-A5	1-B10
24	C18	1n	C-SMD:0805	CS	B-A5	1-B10
25	C20	22u	CE02D	CE02D	T-A6	1-B11
26	C22	22u	CE02D	CE02D	T-A5	1-C9
27	C23	22u	CE02D	CE02D	T-A3	1-D9
28	C24	1n	C-SMD:0805	CS	B-A4	1-C10
29	C25	1n	C-SMD:0805	CS	B-A2	1-D10
30	C26	1n	C-SMD:0805	CS	B-A4	1-C10
31	C27	1n	C-SMD:0805	CS	B-A3	1-D10
32	C28	22u	CE02D	CE02D	T-A5	1-C11
33	C29	22u	CE02D	CE02D	T-A3	1-D11
34	C30	10u	C02C	C02C	T-I6	8-C2
35	C31	100n	C-SMD:0805	CS	T-B3	3-E10
36	C32	100n	C-SMD:0805	CS	T-C3	3-E11
37	C33	100n	C-0.2"	C	T-H7	8-D7
38	C34	100n	C-SMD:0805	CS	T-E2	4-D8
39	C35	100n	C-SMD:0805	CS	T-F2	4-D9
40	C36	100n	C-SMD:0805	CS	T-E2	4-D9
41	C37	100n	C-SMD:0805	CS	T-D2	4-D10
42	C38	100n	C-SMD:0805	CS	T-E4	4-D10
43	C39	100n	C-SMD:0805	CS	T-E4	4-D11
44	C40	100n	C-SMD:0805	CS	T-F2	4-E8
45	C41	100n	C-SMD:0805	CS	T-F2	4-E9
46	C42	100n	C-SMD:0805	CS	T-E2	4-E9
47	C43	100n	C-SMD:0805	CS	T-E2	4-E10
48	C44	100n	C-SMD:0805	CS	T-F3	4-E10
49	C45	100n	C-SMD:0805	CS	T-E3	4-E11
50	C46	100n	C-SMD:0805	CS	T-I3	5-C9
51	C47	100n	C-SMD:0805	CS	T-H3	5-C10
52	C48	100n	C-SMD:0805	CS	T-I4	5-C10
53	C49	100n	C-SMD:0805	CS	T-I2	5-D9
54	C50	100n	C-SMD:0805	CS	T-H2	5-D10
55	C51	100n	C-SMD:0805	CS	T-I3	5-D10
56	C52	100n	C-SMD:0805	CS	T-G2	6-D9
57	C53	100n	C-SMD:0805	CS	T-F2	6-D10
58	C54	100n	C-SMD:0805	CS	T-G4	6-D11
59	C55	100n	C-SMD:0805	CS	T-G2	6-E9
60	C56	100n	C-SMD:0805	CS	T-G2	6-E10
61	C57	100n	C-SMD:0805	CS	T-G3	6-E11
62	C58	100n	C-SMD:0805	CS	T-G5	6-D8
63	C59	100n	C-SMD:0805	CS	T-H5	7-F2
64	C60	100n	C-SMD:0805	CS	T-I6	8-E9
65	C61	100n	C-SMD:0805	CS	T-I7	8-E9
66	C62	100n	C-SMD:0805	CS	T-I7	8-D9
67	C63	100n	C-SMD:0805	CS	T-H6	8-D9
68	C64	100n	C-SMD:0805	CS	T-H6	8-E10
69	C65	100n	C-SMD:0805	CS	T-G7	8-D10
70	C124	100n	C-SMD:0805	CS	T-D6	1-F1

71	C125	4u7	C02A	C02A	T-D5	1-G1
72	C126	100n	C-SMD:0805	CS	B-D5	1-G2
73	C127	4u7	C02A	C02A	T-D5	1-F3
74	C128	4u7	C02A	C02A	T-D5	1-F3
75	C129	100n	C-0.3"	C03N	T-C6	1-G4
76	C130	100n	C-SMD:0805	CS	T-C6	1-F6
77	C131	100n	C-SMD:0805	CS	T-D5	1-G6
78						
79	---D---					
80	D1	1N4148	D-SMD:MiniMELF	DMINIMELF	B-D2	3-B2
81	D2	1N4148	D-SMD:MiniMELF	DMINIMELF	B-D2	3-C2
82	D3	1N4148*	D-0.6"	D06	T-G4	6-B7
83	D4	1N4148	D-SMD:MiniMELF	DMINIMELF	B-C2	3-F2
84	D5	1N4148	D-SMD:MiniMELF	DMINIMELF	B-C2	3-B7
85	D6	1N4148	D-SMD:MiniMELF	DMINIMELF	B-C2	3-C7
86	D7	1N4148	D-SMD:MiniMELF	DMINIMELF	B-H5	7-C4
87	D8	1N4148	D-SMD:MiniMELF	DMINIMELF	B-H5	7-E4
88	D9	boost on/off	LED-3mm	DL	T-I5	7-E11
89	D10	servo on/off	LED-3mm	DL	T-H5	7-B11
90	D11	[undefined]	LED-3mm	DL	T-B5	1-C1
91	D12	15V	DZ-0.4"	DZ	T-B5	1-D1
92						
93	---J---					
94	J1	closed	JMP:Wire-0.1"	J01	T-E4	4-C5
95	J2	closed	JMP:Wire-0.1"	J01	T-H3	5-B4
96	J3	open	JMP:Wire-0.1"	J01	T-H1	2-D5
97	J4	closed	JMP:Wire-0.1"	J01	T-I3	5-G4
98	J5	open	JMP:Wire-0.1"	J01	T-B1	2-D5
99	J6	open	JMP:Wire-0.1"	J01	T-E1	2-D7
100	J7	open	JMP:Wire-0.1"	J01	T-C1	2-D7
101	J8	open	JMP:Wire-0.1"	J01	T-E1	2-E7
102						
103	---N---					
104	N1	HCPL2231	DIP-8	HCPL2231L	T-D2	3-B3, 3-C3, 3-E11
105	N2	HCPL2231	DIP-8	HCPL2231L	T-B2	2-E5, 3-E10, 3-F3
106	N3	HCPL2231	DIP-8	HCPL2231L	T-C2	3-B8, 3-C8, 3-E9
107	N4	OP27*	DIP-8	OP27	T-E4	4-B5, 4-D11
108	N5	DG419	DIP-8	DG419	T-H7	8-C8, 8-E11
109	N6	LF398	DIP-8	LF398	T-H7	8-C6, 8-E9
110	N7	LT1124	DIP-8	LT1124	T-E4	4-B8, 4-D5, 4-D10
111	N8	74HC132	DIP-14	74HC132	T-G5	6-B8, 6-B9, 6-D8, 7-A2, 7-E5
112						
113	N9	OP27*	DIP-8	OP27L	T-H2	5-B4, 5-D10
114	N10	AD620	DIP-8	AD620	T-F2	6-B3, 6-D10
115	N11	OP27	DIP-8	OP27	T-I4	5-D4, 5-D10
116	N12	OP27*	DIP-8	OP27	T-I2	5-D9, 5-F4
117	N13	74HC132	DIP-14	74HC132	T-H5	7-B10, 7-C5, 7-E7, 7-E10, 7-G2
118						
119	N14	TL082	DIP-8	TL082	T-I7	8-C2, 8-C3, 8-E9
120	N17	LT1124	DIP-8	LT1124	T-G2	6-D9, 6-E4, 6-F4
121	N19	LM311	DIP-8	LM311	T-G4	6-B6, 6-D10
122	N25	7805	TO-220	7805	T-A5	1-B10
123	N27	7815	TO220L	7815L	T-A4	1-C10
124	N28	7915	TO220L	7915L	T-A3	1-D10
125	N29	AD620	DIP-8	AD620	T-E2	4-B2, 4-D10
126	N30	AD620	DIP-8	AD620	T-E2	4-D2, 4-D9
127	N31	AD620	DIP-8	AD620	T-F2	4-D8, 4-E2
128	N32	AD620	DIP-8	AD620	T-F2	4-D9, 4-G2
129	N48	AD587	DIP-8	AD587	T-D6	1-F1

130	N50	AD712	DIP-8	AD712	T-D6	1-E5,1-F4,1-F6
131						
132	---P---					
133	P1	10k, front	PT01N	PT	T-F5	4-D4
134	P2	10k	PT01N	PT	T-F5	4-F4
135	P3	10k, front	PT01N	PT	T-F5	4-E4
136	P4	10k, (front)	PT01N	PT	T-E5	4-A7
137	P5	100k	PT01N	PT	T-I8	8-B2
138	P6	1k	PT01N	PT	T-H6	8-C5
139						
140	---R---					
141	R1	5k9	R-SMD:1206	RS	B-C2	3-B2
142	R2	5k9	R-SMD:1206	RS	B-D2	3-C2
143	R3	100k	R-SMD:1206	RS	T-G5	6-B7
144	R4	5k9	R-SMD:1206	RS	B-C2	3-F2
145	R5	5k9	R-SMD:1206	RS	B-C2	3-B7
146	R6	5k9	R-SMD:1206	RS	B-C2	3-C7
147	R7	*	R-0.4"	RO4N	T-D4	4-B5
148	R8	*	R-0.4"	RO4N	T-D4	4-A5
149	R9	*	R-0.4"	RO4N	T-E3	4-B4
150	R10	*	R-0.4"	RO4N	T-E3	4-B4
151	R11	*	R-0.4"	RO4N	T-H2	5-B4
152	R12	*	R-0.4"	RO4N	T-G2	5-A4
153	R13	*	R-0.4"	RO4N	T-H2	5-B3
154	R14	*	R-0.4"	RO4N	T-H2	5-B3
155	R15	1M	R-SMD:1206	RS	T-F2	6-B1
156	R16	100	R-SMD:1206	RS	B-H4	7-E8
157	R17	162k	R-0.4"	RO4N	T-I4	5-D3
158	R18	162k	R-0.4"	RO4N	T-I4	5-D3
159	R19	*	R-0.4"	RO4N	T-I2	5-F4
160	R20	*	R-0.4"	RO4N	T-H2	5-E4
161	R21	*	R-0.4"	RO4N	T-I2	5-F3
162	R22	*	R-0.4"	RO4N	T-I2	5-F3
163	R23	1M	R-SMD:1206	RS	T-E2	4-B2
164	R24	100	R-SMD:1206	RS	B-G4	6-B10
165	R25	5k	R-0.4"	RO4N	T-G3	6-B4
166	R26	510k	R-SMD:1206	RS	B-G4	6-A6
167	R27	100	R-SMD:1206	RS	T-G5	6-A7
168	R28	3k3	R-0.4"	R	T-I7	8-C3
169	R29	10k	R-0.4"	RO4N	T-I7	8-C3
170	R30	10k	R-0.4"	RO4N	T-G3	4-E6
171	R31	100k	R-SMD:1206	RS	B-H4	7-C4
172	R32	56k	R-SMD:1206	RS	B-H5	7-E4
173	R33	750	R-0.4"	RO4N	T-I5	7-D11
174	R34	750	R-SMD:1206	RS	B-H5	7-C11
175	R35	100	R-SMD:1206	RS	B-I4	5-D5
176	R36	1M	R-SMD:1206	RS	T-E2	4-E2
177	R37	1M	R-SMD:1206	RS	T-F2	4-F2
178	R38	1M	R-SMD:1206	RS	T-F2	4-G2
179	R39	10k	R-SMD:1206	RS	B-I7	8-B2
180	R40	100	R-SMD:1206	RS	B-E5	4-D7
181	R41	100	R-SMD:1206	RS	B-E5	4-B9
182	R42	100	R-SMD:1206	RS	B-G2	6-F4
183	R43	100M	R-0.4"	RO4N	T-H7	8-D7
184	R44	24k	R-SMD:1206	RS	B-H7	8-D5
185	R45	5k6	R-SMD:1206	RS	B-H7	8-D5
186	R46	1M	R-SMD:1206	RS	T-D2	4-B2
187	R47	100	R-SMD:1206	RS	B-E3	4-A8
188	R48	1M	R-SMD:1206	RS	T-E2	4-D1

189	R49	1M	R-SMD:1206	RS	T-E2	4-E1
190	R50	1M	R-SMD:1206	RS	T-F2	4-G1
191	R51	100	R-SMD:1206	RS	B-E4	4-C5
192	R52	100	R-SMD:1206	R1206	B-H2	5-B5
193	R53	100	R-SMD:1206	RS	B-H2	5-B5
194	R54	100	R-SMD:1206	RS	B-I4	5-D4
195	R55	100	R-SMD:1206	RS	B-H2	5-F5
196	R56	100	R-SMD:1206	RS	B-I2	5-F5
197	R57	1M	R-SMD:1206	RS	T-G2	6-B2
198	R58	100	R-SMD:1206	RS	B-G2	6-E5
199	R59	100	R-SMD:1206	RS	B-G2	6-D4
200	R60	100	R-SMD:1206	RS	T-G2	6-E5
201	R61	100	R-SMD:1206	R1206	B-G3	6-B5
202	R62	100	R-SMD:1206	R1206	B-G3	6-B5
203	R63	0	R-SMD:1206	RS	B-I1	5-D6
204	R64	50	R-SMD:1206	RS	B-E6	1-E6
205	R65	100	R-SMD:1206	RS	B-G1	6-F5
206	R66	100	R-SMD:1206	RS	B-G1	6-F5
207	R67	100	R-SMD:1206	RS	B-G5	6-A10
208	R68	100	R-SMD:1206	RS	B-A1	6-A11
209	R69	750	R-0.4"	R	T-B5	1-C1
210	R70	100	R-SMD:1206	RS	B-G2	6-D3
211	R158	100k	R-0.4"	R04N	T-D5	1-F2
212	R159	100k	R-0.4"	R04N	T-D5	1-F3
213	R160	1k	R-0.4"	R04N	T-C5	1-G4
214	R161	50	R-SMD:1206	RS	B-C6	1-F4
215	R162	1k	R-0.4"	R04N	T-D6	1-E4
216	R163	1k	R-0.4"	R04N	T-D6	1-E5
217						
218	---S---					
219	S1	[undefined]	S1X2S01N	S1X2S01N	T-C4	3-B4
220	S2	[undefined]	S1X2S01N	S1X2S01N	T-D4	3-C4
221	S3	(FRONT)	S1X2W01N	S1X2W01N	T-C3	3-A3
222	S4	(FRONT)	S1X2W01N	S1X2W01N	T-D3	3-B3
223	S6	[undefined]	S1X2S01L	S1X2S01L	T-C4	3-F4
224	S8	[undefined]	S1X2S01N	S1X2S01N	T-C3	3-E3
225	S9	[undefined]	S1X2S01L	S1X2S01L	T-E5	4-D6
226	S10	[undefined]	S1X2S01L	S1X2S01L	T-F5	4-G4
227	S11	[undefined]	S1X2S01N	S1X2S01N	T-C4	3-B8
228	S12	[undefined]	S1X2S01N	S1X2S01N	T-C4	3-C8
229	S13	FRONT	S1X2W01N	S1X2W01N	T-C3	3-A8
230	S14	FRONT	S1X2W01N	S1X2W01N	T-C3	3-C8
231	S15	[undefined]	S1X2S01L	S1X2S01L	T-F5	4-E5
232	S16	[undefined]	S1X2S01L	S1X2S01L	T-E5	4-B8
233	S17	[undefined]	S1X2S01L	S1X2S01L	T-G5	6-B9
234	S18	[undefined]	S1X2S01N	S1X2S01N	T-H6	7-A8
235	S19	[undefined]	S1X2S01N	S1X2S01N	T-H6	7-C8
236	S20	[undefined]	S1X2S01L	S1X2S01L	T-E8	8-C10
237						
238	---X---					
239	X1	IN2	X09-DSUBMALE1	X09-2S-DMAL	T-D1	2-B6,2-D7
240	X2	HVMON	LEMO:1-pin/horz.	XS-4S	T-I1	5-D6
241	X3	TRIGGER	LEMO:1-pin/horz.	XS-4S	T-G1	6-B1
242	X4	5V	Testpin:0.8mm/ceramic	XT	T-A5	1-B11
243	X5	IN1	X09-DSUBMALE1	X09-2S-DMAL	T-C1	2-B3,2-D7
244	X6	[undefined]	Backplane:96-pin/ABC	XB96	T-B8	1-C3,1-C4,1-C6
245	X7	[undefined]	Backplane:96-pin/ABC	XB96	T-H8	1-C7,1-C8
246	X8	IN3	X09-DSUBMALE1	X09-2S-DMAL	T-F1	2-B9,2-E7
247	X9	OUT1	X09-DSUBFEMALE1	X09-2S-DFEM	T-B1	2-D5,2-E3

248	X10	OUT2	X09-DSUBFEMALE1	X09-2S-DFEM	T-H1	2-D3,2-D5
249	X11	REF	Testpin:0.8mm/ceramic	XT	T-G3	4-E7
250	X12	RAMPON	Testpin:0.8mm/ceramic	XT	T-H6	8-B8
251	X13	(RELOCK)	Crimp:RG174/vert.	XC	T-H4	7-E8
252	X14	RAMP	Testpin:0.8mm/ceramic	XT	T-E8	8-C11
253	X15	RESONANT	Crimp:RG174/vert.	XC	T-G4	6-C10
254	X16	TRIGGER	Testpin:0.8mm/ceramic	XT	T-G2	6-E5
255	X17	TRIGGER MON	Crimp:RG174/vert.	XC	T-G1	6-F6
256	X18	COMP	Testpin:0.8mm/ceramic	XT	T-G4	6-B7
257	X19	[undefined]	X03AN	X03AN	T-B5	1-E8
258	X20	[undefined]	Testpin:0.8mm/ceramic	XT	T-G4	6-B6
259	X31	+10V unfiltered	Testpin:0.8mm/ceramic	XT	T-D5	1-F2
260	X32	+15V	Testpin:0.8mm/ceramic	XT	T-A4	1-C11
261	X33	-15V	Testpin:0.8mm/ceramic	XT	T-A3	1-D11
262	X34	+24V	Testpin:0.8mm/ceramic	XT	T-C8	1-C9
263	X35	-24V	Testpin:0.8mm/ceramic	XT	T-D8	1-D9
264	X36	W5	Testpin:0.8mm/ceramic	XT	T-E3	4-B3
265	X37	W6	Testpin:0.8mm/ceramic	XT	T-E6	4-B10
266	X38	GAIN	Testpin:0.8mm/ceramic	XT	T-E6	4-D7
267	X39	[undefined]	Testpin:0.8mm/ceramic	XT	T-A6	1-E9
268	X40	INOFFSET	Testpin:0.8mm/ceramic	XT	T-F6	4-G6
269	X41	+10V filtered	Testpin:0.8mm/ceramic	XT	T-C5	1-F3
270	X42	-10V filtered	Testpin:0.8mm/ceramic	XT	T-D6	1-E5
271	X43	W1	Testpin:0.8mm/ceramic	XT	T-H3	5-B2
272	X44	W2	Testpin:0.8mm/ceramic	XT	T-H3	5-B5
273	X45	W3	Testpin:0.8mm/ceramic	XT	T-I3	5-D2
274	X46	W4	Testpin:0.8mm/ceramic	XT	T-I3	5-F5
275	X49	RAMP	Testpin:0.8mm/ceramic	XT	T-I6	8-B4
276	X50	[undefined]	Testpin:0.8mm/ceramic	XT	T-D8	1-E9
277	X51	[undefined]	Testpin:0.8mm/ceramic	XT	T-I5	1-E10
278	X52	[undefined]	Testpin:0.8mm/ceramic	XT	T-E3	1-E10